

RADIUS: Rapid Automated Decomposition of Images for Ubiquitous Sensing

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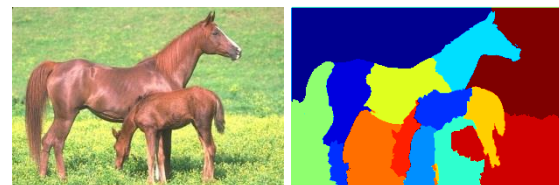
RADIUS: Rapid Automated Decomposition of Images for Ubiquitous Sensing

Polygonal features from sparse edge information for timely and automated analysis of big data imagery

BACKGROUND & MOTIVATION

State-of-the-art pixel and color based methods do not exploit the multiscale spatial and structural cues in images for effective and efficient analysis

- Miss large or small features
- Limited scalability to large images



Simple figure-ground raster image with good color contrast

State-of-the-art (N-cuts) pixel method's feature decomposition

INNOVATION

Modeling perceptual grouping of image edges and regions for rapid, hierarchical, multiscale, polygonal feature extraction and analysis.



Two stages of our hierarchical region-edge based polygonization of above raster image into features showing good feature delineation

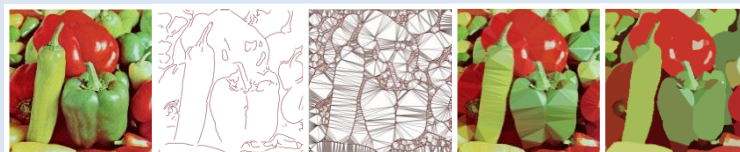


Changes between images of a scene as contextual anomalies in their difference image

DESCRIPTION

RADIUS computes polygonal features at multiple scales to structurally characterize images in a hierarchical manner using a pyramidal graph structure. RADIUS easily adapts custom algorithms for various image analysis applications.

RADIUS first uses image edge pixels (Fig. b), to obtain a Delaunay triangulation of the image (Fig. c). The triangulation is an image-adaptive grid from which perceptual cues of human vision such as proximity, symmetry, and continuity between edges are computed. These serve as grouping criteria to merge the spectrally sampled triangles (Fig. d) into visually meaningful polygons (Fig. e). :



a. Pixel image b. Edge pixels c. Proximity graph d. Color sampling e. Polygonization

With this initial polygonization as a starting point, RADIUS enables a hierarchical scheme for extracting multiscale features by successive grouping of polygons, obtained as above, based on structural, spectral, and statistical attributes:



Hierarchical segmentation by successive polygon grouping showing emergence of fine to coarse features.

RADIUS is TRL 4 – Developed an industry operational mode tool for change detection assay in aerial imagery that is currently being evaluated for deployment.

Patents constituting RADIUS:

- Multiscale Characterization and Analysis of Shapes, U. S. Patent # 6,393,159
- Vectorized Image Segmentation via Trixel Agglomeration, U. S. Pat.# 7,127,104
- Image Segmentation by Hierarchical Agglomeration of Polygons using Ecological Statistics. U.S. Patent # 8,428,354

ANTICIPATED IMPACT

Increased analyst performance

- Real-time automated image analysis
- Direct analyst to selected features in the images

Enhanced analysis capabilities

- Rapid Segmentation of Large Images
- Hierarchical Image Analysis
- Spatial Image Description
- Anomaly & Change Detection and ID
- Feature Shape & Context Analysis
- Object Recognition
- Vector ESRI Shape file Representation

PATH FORWARD

Technology demonstration with partners:

- Seeking new Government and commercial partners to demonstrate technology with real world scenarios

Validate and harden algorithms using complex data sets:

- National security applications
- Biomedical and environmental applications
- Materials science

Potential End Users:

- DOE, DOD, DHS
- Aerospace (Geospatial Intelligence)
- Biomedical and Radiographic

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